Space Flight as an Anticipatory Computing System

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Abstract. This paper presents an astronaut's view of the global efforts to explore space. The seminal work in Earth and Lunar orbits by both the Soviet Union and the United States required only classical Newtonian physics to accomplish the initial steps. These early efforts, however, illuminate the limitations not only of classical physics but also of general relativity if humanity aspires to go deep into or beyond our solar system. The limitations of the early interpretations of special and general relativity, and the conflicts with quantum mechanics have dominated physics for this entire century. The ability now to experiment with the space vacuum, to orbit sophisticated instruments and to travel beyond the earth/moon system, excite the imagination to think beyond toward the possibility of exploring intragalactic space. Experimental results and new theory call into question the limitations imposed by classical theory. They offer hope that humankind is not forever confined to the solar system. I examine some of those ideas in this paper.

Keywords: space travel, exploration, quantum mechanics, planets, consciousness, relativity

INTRODUCTION

The opportunity to explore the lunar surface with Alan Shepard in 1971 was certainly the apogee of my twenty-five year career as a pilot, test pilot and astronaut. Second only to that event was an encounter in 1972 when as astronaut delegate to a NASA futures planning conference I was in residence for a week with Wernher von Braun and Arthur C. Clarke, two of the most visionary thinkers of our century.

It has been an enormous pleasure and a great privilege for me to have participated with giants such as these, plus the thousands of others who helped make Earth's civilization an extra-terrestrial enterprise in this century. It is regrettable, but likely necessary, that we have languished for almost thirty years in Earth orbit since Apollo with neither the boldness nor the leadership to continue exploration of the solar system in an aggressive way. Necessary, because it is clear that we do not have the global vision, the political will nor the economic resources to undertake deep space exploration enthusiastically. We must proceed at a snail's pace to tease nature's secrets from the cosmos, and wait until the right political time for additional deep space exploration by humans.

We went to the Moon for political reasons, to establish political and technological dominance in space for the western world. At least that is the reason the U.S. government provided funds and the leadership. And it is the reason that the American public supported it; a space race against communist ideology. That is not the reason most of the participants of the American space program were involved, it was the excuse that made it possible. We were there for exploration, for technological and scientific progress—and for adventure. A political rationale was perhaps superficial, but better than no program at all. As a result of political and public apathy once that dominance was achieved, only seven of the ten landing missions were launched, and one had to return without landing. The scientific accomplishment, although great, fell far short of what we had hoped to achieve with Apollo. And, the Apollo landings were accomplished largely with classical Newtonian science. Except for communications technologies and small thermonuclear generators to power certain lunar surface experiments, no scientific breakthroughs nor exotic quantum technologies were required to accomplish Apollo. The design

criterion was "state of the art" as much as possible in order to meet President Kennedy's constraint of "—by the end of this decade."

As a pilot and astronaut, my interests were primarily on the engineering concerns of propulsion, navigation and control. Successful lunar science depended first upon successful control and piloting of the vehicles to take us there. The techniques employed were classical anticipatory computation, that is, appropriate Keplerian orbits were selected in near Earth space, translunar space, and near lunar space. They were linked at the points of major engine burns where the space craft would transition from one orbit to the next, then let gravitation do the rest. Newton's classical laws were all applied. Ground tracking was done by Earth based sensors and perturbation theory was used to compute corrections for return to the desired flight path. On board control was maintained by stable platforms which were aligned through sighting on a few of the sixty four major navigational stars. The system was simple, classical and effective; an extension of Earth bound sea and air navigation systems but with primary computation and navigation from mission control on Earth rather than aboard the spacecraft. It is of interest to point out, in this day of massive desk top computers, that the onboard computers for each of the spacecraft enjoyed 64K bits of memory operating at much less than 10 mhz. On the spacecraft, the crew was responsible for physical control of the spacecraft, management of its systems, alignment of the stable platform, executing thruster and major engine maneuvers. Most importantly, however, the crew had primary responsibility in compensating for equipment failure and providing judgment in times of crisis, both in space and on the lunar surface. Nominal missions required about one-third of the training time. The rest was consumed in contingency training.

Today, as we ponder the planets of our solar system, the stars and galaxies beyond, they seem almost as out of reach for humans as they did thirty years ago. It is very likely, however, that the planets of our solar system will be reached in the near future, beginning with Mars, when we find the political will to go there. No major new technologies are required, only the commitment. However, there was a small communications time delay on lunar missions. The two second delay for transmissions between the Earth and the Moon was a mere annoyance to flight operations for Apollo, it is a harbinger of more difficult problems which will beset us as we reach for the outermost planets and beyond. The relatively simple robotic probes now in use to explore the major planets of Sol can be managed from Earth control centers in spite of the agonizing hours of time delay to obtain a reply from a distant spacecraft. Human voyagers will require much more autonomy and would be unable to function effectively if required to rely upon such communications. With today's technology the Martian exploration will require a minimum of three years mission duration and communications transit time of about 40 minutes. That is difficult operationally but is achievable.

Of greater interest to me, however, is the larger picture and preparations for exploration beyond our solar system. The scientific and technological development of this century has been astounding. From horse back transportation to lunar exploration in just over 100 years is rapid progress. But we are as yet primitive, juveniles in the cosmic scheme of things. Certainly there are technological civilizations in our galaxy thousands, perhaps millions, of years older than we. Recognition of this likelihood has been slow in coming, but it has been accelerating rapidly over the past three decades since Apollo, so that most knowledgeable people today accept this possibility.

The great discoveries of the early twentieth century brought us special and general relativity, then quantum mechanics. But almost none of this knowledge was needed to go to the moon as we worked with classical Euclidian space and Keplerian orbits. Never-the-less, relativity seemed to confine us to our solar system with its speed of light limitation. Conventional wisdom has decreed for almost a century that the speed of light is an absolute barrier, effectively precluding humans from galactic travel. It would now seem, however, that another revolution is taking place which will produce extensions and major changes to both relativity theory and quantum mechanics, just as relativity and the quantum added to classical theories. These changes have come about precisely because of the ability to look greater distances into space, to look deeper into matter, to place instruments and sensors in Earth orbit, and to achieve high energy interactions. Perhaps we can break out of our solar confinement. The developments in question are chaos theory, confirmation of quantum theory's non-locality, discovery of the quantum hologram, metric probing of the zero point field, orbiting atomic clocks and observations of the early universe. It is these developments that I want to discuss, for they point the way to future space flight into the galaxy and beyond.

DISCUSSION

As a hopeful galactic navigator, if not for me then for our progeny, it is paramount that we understand the medium we are traversing in the same way the earliest sea faring peoples learned the oceans, and aviators learned the atmosphere. Our

operational task is to get from here to there and, hopefully, return. To go to the moon we used Newtonian physics and flat Euclidean space. It is abundantly clear that such theory is insufficient for travel beyond our solar system.

The Michelson/Morley experiment at the turn of the century banished the ether from twentieth century physics. Quantum theory has required reincarnating the ether concept in altered form as the zero point field to account for the seething cauldron of particles, anti-particles, virtual particles and quantum fluctuations that appear and disappear in nature. Obviously interplanetary space, interstellar space and intergalactic space is not empty, even if we exclude the ephemeral clouds of gases and the matter ejected from ancient stars. Einstein suggested that space itself is curved because the tensor mathematics of Georg Riemann so elegantly model space, time and gravitation in general relativity. And, experiments seem to confirm this interpretation. But if that is true, what is it that is curving? Emptiness and nothingness cannot curve! There needs to be something, some substance that makes up the fabric of space/time to create the effect of curvature. Haisch, Rueda and Puthoff (1,2,3) have been theorizing and experimenting with the properties of the zero point field for much more than a decade from the point of view of Stochastic Electro-Dynamics (SED). They argue convincingly that measurable properties of the zero point field are neither homogeneous nor isotropic and may more accurately account for the apparent relativistic curvature of space than does a warped space frame. Further, they theorize that the enigmas of mass, inertia and gravitation may not be fundamental properties at all, but directly the result of electrodynamic interactions between the electromagnetic properties of matter and the underlying zero point field. The fact that the measured masses of individual constituent particles is greater than their combined mass in an atomic nucleus, and, that the discrepancy may be accounted for by electrodynamic interaction, lends credence to this idea.

Recent data from the Hubble Space Telescope and other space borne sensors have caused a flurry of new activity in cosmology and in cosmic topology computations. It is no longer clear how fast and or how far the initial inflation of the big bang extended. Or, whether the big bang was as hot as the inflationary model suggests, or just one of many in a sea of warm multi-bubble universes. It is no longer clear whether the most distant galaxies observed are really that distant, or are we just viewing our own backsides in a hall of mirrors. A few strong voices even suggest the big bang is a flawed theory. Further, quantum states have now been teleported over 400 kilometers.

Science has struggled for almost a century with the discrepancies between special relativity, general relativity and quantum mechanics without the technological means to seek resolution until the current era. Special relativity (SR) counts all moving reference frames as equal since the speed of light is measured as the same in each, and it denies the ability to define an absolute rest frame. But SR was formulated after the Michelson/Morley experiment and before the Hubble expansion was discovered. If the big bang is in fact a point of origin of the universe, then a frame defined at that point can be considered as a rest frame even though the point may not be directly measurable. The Doppler shift in black body background radiation from the big bang, however, gives a vector of movement for our galaxy, presumably away from the origin. Van Flandern has argued (4,5,6) that measurements from orbiting atomic clocks of the Global Positioning System (GPS), give results for relativistic time dilation that are more accurate by a factor of 4 in the context of Lorentzian relativity (LR) than for special relativity (.7% for LR vs 3% for SR). The atomic clocks are calibrated to within a few nanoseconds. LR permits a rest frame to exist, it assumes an ether and permits simultaneity in the universe. SR denies these assumptions. However, in most cases of matter/energy conversion, LR and SR yield similar results. The differences in LR and SR, while often numerically small, have profound implications. Lorentzian relativity is more easily reconciled with general relativity than is SR.,

Van Flandern has approached the issues differently than Haisch, Rueda and Puthoff. The former has looked for anomalous measurements in astrophysical data, whereas the latter team is concerned with the quantum electrodynamic phenomena of the zero point field. But Van Flandern has also challenged the classical space curvature interpretation of general relativity (GR). He correctly points out that curved space is an interpretation of GR not a requirement. Van Flandren also argued (4) that if gravitation is a propagating force and not the result of space curvature, in order to have infinite range, it must also have instantaneous effect. Using the light aberration argument of Laplace (7) but with modern measurements, he places a lower limit on the propagation velocity of gravitation at 10^{10} c. He also argues that if gravitation is carried by particles the mean free path of the particles before scattering takes place is likely between 1-2 kilo parsecs. This particle model of gravity will then approach an inverse linear relationship at distances greater than 2 kilo parsecs rather than the classical Newtonian inverse square relationship which is preserved in GR. Van Flandern cites astrophysical measurements which support his claim and also to refute the curved space interpretation of GR.

These challenges to a number of classical and relativistic sacred cows of this century is not surprising, as science has always progressed by pursuing anomalies to the existing order. They are only possible because of the technological advances, including space flight, which have extended our view deeper into the universe. However, the implications of these observed anomalies is enormous. Are the simultaneity required by quantum non-locality and the required super luminal speed of gravity particles related phenomena? Is non-locality truly instantaneous or just very, very fast? Or, are both gravitation and non-locality really instantaneous? In either case it is the propagation of information about a physical object that is fundamental. And information is only now being recognized as having fundamental importance to all of science.

To escape our solar prison and to explore intra and inter galactic space it is certain that propulsion systems far beyond current technologies are required. Chemical and nuclear fuels simply will not suffice, nor will classical communications. Puthoff (personal communication) expects that investigations of the zero point field will eventually yield useable energy sources for deep space propulsion. NASA projects have already been awarded to study such advanced systems as well as recently announced projects to extend and expand the search for exo-biology. If humans are to progress deeper into the cosmos than our own solar system, these studies must be brought to fruition and the speed of light barrier must be broken through new understanding.

Alcubierre has proposed a method of engineering the zero point field to produce warp speeds. Although criticized as being energy prohibitive, it should be no more so than creating a worm hole in space, particularly if the energy of the zero point field itself can be utilized as Puthoff proposes (8). These advanced theoretical concepts are yet in their infancy and, as in all of science, must be advanced through experiment toward eventual perfection.

It is my opinion (9) that quantum non-locality is a major key to the scientific puzzles plaguing quantum theory and relativity. Dismissed for most of this century as a curious artifact of subatomic particle interaction, non-locality is beginning to emerge as an important phenomenon. The impediment has been the speed limit imposed by special relativity and the erroneous belief that non-local information was not recoverable. The non-local quantum hologram has been discovered experimentally, the graviton has not but its effects are universally recognized. Both require very, very fast propagation, if not instantaneous simultaneity. Gravitation holds the universe together, the quantum hologram helps it self organize (10). It is likely that resolving the mechanics of non-locality will finally resolve conflicts between theories of the very, very small, the very, very fast and the very, very large. It will allow information and consciousness to be recognized as the "flip side" of energy, and as important as matter in the organization of the cosmos.

In a little know report, Krichevskii (11) records the experiences of two Russian cosmonauts living aboard the Mir spacecraft for six months. Their concerns about official reaction to the experience requires their anonymity. I cite the report in this paper because the quantum hologram offers a valid explanation for the unusual experiences of the cosmonauts. They each, but not simultaneously, experienced dream and waking states featuring extraordinary perceptions. They also experienced distorted time perception during these events. The cosmonauts frequently perceived themselves as other creatures on Earth, including dinosaurs, other humans and extraterrestrials. They discussed these experiences in great detail, including hearing voices, instructions and precognitive predictions about their spacecraft's future problems, which were all subsequently fulfilled. They experienced these events as though the information originated outside themselves. With good reason they could not report these events to their controllers nor to the medical monitors for fear of mental disqualification and loss of flight status. Only the quantum hologram permits a framework to explain these events within the context of science, without resorting to hallucination and mental dysfunction.

Most astronauts and cosmonauts have had a heightened awareness and profound insights during prolonged space experiences. Though discussed privately, but seldom reported officially, these experiences must now be considered in the context of long duration space voyages. The book *The Home Planet* (12) provides only an intriguing taste of these experiences in its brief captions to the inspiring photographs. For the purposes of this paper, I raise the question: "Does the quantum hologram and non-locality offer a new avenue for research into alternative communication for space travel?" Alcubierre with the warp drive, Van Flandern with astrophysical measurements, and Haish, Rueda, Puthoff with zero point field theory, have raised serious and vital questions about the validity of certain quantum and relativistic interpretations. Non-local information has been considered a useless curiosity, except to entangled particles, for most of this century. It now appears to be the basis for our most personal experience---subjectivity (10). Does this also mean that we perhaps can find a method which builds upon current knowledge of quantum computing, quantum holography and non-locality to communicate across the universe when we can go there?

Anticipatory computing systems require not only of the current state of the system but knowledge of the desired state to be achieved. We explored the lunar surface using anticipatory computing systems based upon classical Newtonian and Keplerian principles. But clearly they are insufficient to go beyond our solar system. We are in the process of convincing ourselves that the limitations of special relativity, the predictions of general relativity and the interpretations of early quantum theory are not absolute, but rather stepping stones to a new understanding of the cosmos and how to explore it. It is the human destiny to explore our world. We may use robots to lead the way, but we will not feel that we have fulfilled destiny until we make it a personal journey. And to do so, we must break the light barrier both in propulsion and communications technologies. My article of faith is that we shall be able to do so in the coming decades. So, "Beam me somewhere, Scotty."

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